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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/812,734	03/30/2004	Shau-Lin Shue	TS00-101C	4809
7590		11/23/2004	EXAMINER	
George O. Saile		SMITH, BRADLEY		
28 Davis Avenue		ART UNIT		
Poughkeepsie, NY 12603		PAPER NUMBER		
		2824		

DATE MAILED: 11/23/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

10/812,734

Applicant(s)

SHUE ET AL.

Examiner

Bradley K Smith

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 04 October 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1 and 32-56 is/are pending in the application.
- 4a) Of the above claim(s) 1 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 32-56 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 30 March 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date 5/6/04.
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☒ Other: search notes.

**DETAILED ACTION**

***Election/Restrictions***

1. Claim 1 is withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to a nonelected invention, there being no allowable generic or linking claim. Applicant timely traversed the restriction (election) requirement in the reply filed on 11/4/04.
2. This application contains claim 1 drawn to an invention nonelected with traverse in Paper No. 11/4/04. A complete reply to the final rejection must include cancellation of nonelected claims or other appropriate action (37 CFR 1.144) See MPEP § 821.01.
3. Applicant's election with traverse of the restriction in the reply filed on 8/31/04 is acknowledged. The traversal is on the ground(s) that the embodiments are not patentably distinct. This is not found persuasive because the attorney fails to specifically articulate how the embodiments are distinct.

The requirement is still deemed proper and is therefore made FINAL.

***Specification***

4. The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

The following title is suggested: A Self-Passivated Copper Interconnect Structure.

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1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 32, 33, 35, 40, 41, 43, 48, 49, 50 and 52 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ding et al. (US Patent 6,387,805) in view of Adams et al. ("Titanium-nitride self encapsulation of Cu and Ag films on silicon oxide"). Ding et al. disclose an insulating layer over the substrate, an opening in the insulation layer on the substrate, a fill layer of Cu-Ti over the insulating layer (see column 7). With regards to claims 33, and 50 form a barrier layer over the insulating layer, and under the fill layer with Ti (see column 7). With regards to claims 35, 43, and 52 Ding et al. disclose the formation of an oxygen rich titanium layer (column 6 lines 50-55). With regards to claims 40, 48 and 49 Ding et al. disclose titanium is distributed uniformly in the copper fill. However Ding et al. fail to disclose the self passivation layer comprised of titanium nitride over the fill layer. Whereas Adams et al. disclose the nitridation of a copper titanium layer to form titanium nitride. Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made combine the teachings of Ding et al. and Adams et al., because the titanium nitride layer would protect the copper layer and it would be easier to nitridize the copper titanium layer than to deposit a blanket layer of titanium nitride over the whole substrate.

3. Claims 32, 33, 37-39, 41, 45-47, 49, 50, and 54-56 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jiang et al. (US Patent 6,693,356) in view of Adams

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et al. ("Titanium-nitride self encapsulation of Cu and Ag films on silicon oxide"). With regards to 32, and 49 Jiang et al. disclose an insulating layer over the substrate, an opening in the insulation layer on the substrate, a fill layer of Cu-Ti over the insulating layer. With regards to claims 33, 41, and 50 Jiang et al. disclose a barrier layer between the insulation layer and the fill layer. With regards to claims 37-39, 45-47 and 54-56, Jiang et al. discloses a tantalum nitride barrier layer with a thickness of 1nm-50nm (see column 4 lines 35-50). However Jiang et al. fail to disclose the self passivation layer comprised of titanium nitride over the fill layer. Whereas Adams et al. disclose the nitridation of a copper titanium layer to form titanium nitride. Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made combine the teachings of Jiang et al. and Adams et al., because the titanium nitride layer would protect the copper layer and it would be easier to nitridize the copper titanium layer than to deposit a blanket layer of titanium nitride over the whole substrate.

4. Claims 34, 36, 42, 44, 51 and 53 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ding et al. (US Patent 6,387,805) in view of Adams et al. ("Titanium-nitride self encapsulation of Cu and Ag films on silicon oxide") as applied to claims 32, 41, and 49 above, and further in view of Gabriel et al. (US 6,472,231). Ding et al. and Adams disclose the providing an insulating layer over the substrate, an opening in the insulation layer on the substrate, a barrier layer over the insulating layer, a fill layer of Cu-Ti over the insulating layer. However with regards to claims 36, 44, 53, Ding et al and Adams et al. fail to disclose the formation of a dual damascene structure. With

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respect to claims 34, 42 and 51 Ding et al and Adams et al. fail to disclose the low-k dielectric insulation layer. However Gabriel et al. disclose the use of both the low-k dielectric insulation layers and a dual damascene structure (column 1 and column 3). Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine Ding et al and Adams et al. with Gabriel et al., because the use of the elements is common in the art (it was described in Gabriel's background of the invention).

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Bradley K Smith whose telephone number is (571) 272-1884. The examiner can normally be reached on 10-6 Monday through Friday.

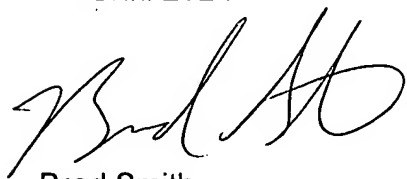
If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Richard Elms can be reached on (571) 272-1869. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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A handwritten signature in black ink, appearing to read 'Brad Smith', with a stylized, cursive script.

Brad Smith  
Primary Examiner  
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